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THOUGHTS

ON

NATURAL PHILOSOPHY

(WITH A NEW READING OF NEWTON'S FIRST LAW);

AND

THE ORIGIN OF LIFE.

BY

A. BIDDLECOMBE.

NEWCASTLE-UPON-TYNE:
R. WARD & SONS, PRINTERS AND STATIONERS, 31 TO 39, HIGH BRIDGE.
1908

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"Plato is my friend, but truth is a greater friend."

THIRD EDITION, REVISED AND ENLARGED.

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FOREWORD.

THE author desires to explain that the method in which he has attacked the great problem with which this treatise deals was settled for him by the fact that it was the discovery of Radium by Madam Curie, and the philosophic explanations of Professors Rutherford and Soddy with regard to radium phenomena, that enabled him to jump to the apprehension of the speed theory of material combination, which has formed the germ from which this sketch of a true natural philosophy has developed.

His acknowledgments and thanks are due to the many eminent men, at home or abroad, living or dead, who have helped him by their books, their delicate and difficult experiments, their wonderful calculations and clever practical work. They are too truly great to be offended by the efforts of another, however humble, to solve, with their assistance, the great unsolvable. Write with diffidence for the great he must; but their greatness only gives him confidence, because he knows that he is taking his pearls to a right market, where they can be tested and appreciated, where their beauty will please and their purity entrance.

In referring to Sir Isaac Newton the author has no desire to belittle his genius. Sir Isaac was a giant; but like other great men he made mistakes. It would be unwise to accept and perpetuate what is untrue.

INTRODUCTION.

Throughout the ages there have been many philosophers great and small. The word "Plato" may for convenience be taken to express and include the sum of them. Then, as scientific inquirers, we may well have for our device the well-known quotation: "Plato is my friend, but truth is a greater friend." We are searchers after truth, we revere our teachers; but not all our affectionate reverence or awe of great men, living or dead, can stay us in our quest. Truth alone is sovereign.

The subject of religion is not dealt with in this theory. We all agree that the ordinary operations of nature are carried on under the rule of what we term "natural law." It is my endeavour to elucidate that law.

The nomenclature adopted is that of the radium experimenters, because I wished to state the case as stated by them. There is not any magic in names; and it does not much matter what you call a thing so long as the term is clearly defined at the start, and you abide by that term and definition throughout the argument. Scientific terms are but words applied to temporary arrangements of matter caused by the speed, weight, and movements of material portions. This is to be remembered in order that we do not get lost in a forest of names, or allow scientific terms to obscure our vision of the reality and cause of things.

Natural philosophy does not belong entirely to scientific experimentalists and mathematicians. When the first have made their delicate and difficult experiments, and the others have worked out their intricate problems, then, if either or both of them commence to construct a system of philosophy, the logicians come in, and it is their high duty to test the reasoning of the philosophers. If that reasoning cannot stand the necessary tests, the philosophy must be cast aside, no matter who may be its author. The work of the logician is necessary, because some of the suggestions of learned men are fit only for *Alice in Wonderland*, where a thing can be a pussy-cat and not a pussy-cat at the same time.

Sir Isaac Newton himself appears to have had his doubts. He at one time thought of endeavouring to account for orbital phenomena by differences of pressure in the ether, but did not publish a theory on the subject.

In Newton's *Principia* the first law is that "Every body continues in its state of rest or of uniform motion in a straight line, except in so far as it may be compelled by impressed forces to change that state."

Let us transpose the wording as follows:—Every body continues in its state of uniform motion in a straight line, or in its state of rest, except in so far as it may be compelled by impressed forces to change that state.

The reason that the law as transposed is more correctly stated is as follows: It is acknowledged by scientific inquirers that in scientific matters we must reason from the known to the unknown. The only state of rest known to us is a relative and occasional state. Take a book between the two hands, apply an upward and a downward pressure; when the pressure is equal in opposite directions a state of equilibrium will result, and the book will be at rest. The force that causes this state of rest is energy exercised in opposite directions. What is true of the book is true of other matter. Energy (or material motion) causes the state of rest, therefore energy (or material motion) must be the original thing, and rest a secondary matter or effect. To take the effect as the basis of an argument or system of philosophy, and then invent some imaginary force (which, after all, can only be a name, a word, a no-force) to account for phenomena caused by a force already in existence is fallacious and absurd.

The first law should therefore be that:—Every body continues in its state of uniform motion in a straight line or in its state of rest, except in so far as it may be compelled by motion or force to change those states.

The advantage of this amended law is that you are dealing with known things, and in their right order, and do not have to imagine fanciful ideas.

This amended law agrees with my axiom that "Two portions of matter, moving adjacent at equal rates of speed along a straight line, must continue to move together as long as their rates of speed remain equal, and they do not receive any interference."

This is the fundamental law of material combination. When they meet other portions of matter and clash, they combine to execute the work of moving the other portions, or are moved, as the case may be; but either way they combine to exercise force and do work.

The birds in the air, the fishes in the water, animals on land, and all moving things illustrate the truth of the axiom. As long as they move adjacent to one another, at equal rates of speed, along a straight line, without interference, they keep together.

Matter, having motion, must have speed and direction, and therefore eventually adjacency.

Material motion gives the sensation of heat, and is called "energy." The word "energy" is only a name given to material motion.

Electricity and magnetism are material motion in special forms or modes, and only in operation when material motion takes those forms or modes. This accounts for the fact that we get heat without electricity and magnetism, and that when we have electricity and magnetism we have heat. It also accounts for the apparently occasional character of electricity and magnetism, on which subjects much has to be said later on.

*Gravitation, *as conceived in the Newtonian philosophy*, does not exist—is purely imaginary and fallacious; but, as the force that keeps the planets in their orbits is centripetal, the mathematical problems stand. So for the future you may trust Newton's mathematics, but not his philosophy. But, of course, it is true that objects verticate towards the earth as a result of the action of the ether, while they gravitate to it in a somewhat similar manner to the way in which a piece of wood floating in the water may be said to gravitate towards the shore by the action of the incoming tide.

Take a bar magnet, and break it as often as you will, the portions are still magnetic, leading to the conclusion that the molecules are magnetic, and exert such an influence upon the ether by their motion as to drag smaller objects to the magnet. Magnify one of these tiny magnets to the size of the earth, and imagine a man standing upon it: he sees that smaller objects approach it, and wishing to find a cause that will account for the phenomena, and not being able to see the ether, he imagines the fictions of the inherent attraction of matter, and consequent action at a distance. But his supposition is not according to fact, it is material motion in and by the mass and the ether, and action by contact, that accounts for the phenomena. Combine the varied motions of corpuscles, atoms, molecules, stars, suns, planets, ether, etc., and fictions are quite unnecessary and objectionable, the facts are sufficiently stupendous and adequate to produce the inevitable and natural results.

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*By the Newtonion I mean that philosophy that starting from a state of rest imagines the motion of matter to have been caused by the mutual attractions of its smallest portions.

Newton himself in his letter to Bentley appears to contradict the fiction of the inherent attraction of matter by matter, he wrote to Bentley as follows:—" It is inconceivable that inanimate brute matter should, without the mediation of something else which is not material, operate upon and affect other matter without mutual contact, as it must do if gravitation in the sense of Epicurus be essential and inherent in it. That gravity should be innate, inherent, and essential to matter, so that one body can act upon another at a distance through a vacuum, without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man, who has in philosophical matters a competent faculty of thinking, can ever fall into it."

It is interesting to note that on this subject both Descartes and Newton were right, in the main, and up to a certain point, allowing for what we now can see was erroneous. Newton in his idea (up to a certain point) of gravitation; and Descartes (with a margin for errors) in his idea of vortices. It is the Vortices not of Descartes, but of nature that causes the gravitation (or rather vortication) that Newton sought to mathematically demonstrate, and that experiment and observation has confirmed. To Descartes and Clerk Maxwell must ever belong the honour of drawing attention thereto and doing their utmost to make clear the same. But Vortices must be formed. How? Matter having motion, must have direction and eventually adjacency, and collision. The collisions give variety to the movements, and amidst the many clashings some portions will take the necessary spin (travelling with others of the same speed) to give the vortical force and produce the inevitable vortices in the ether, as in the case of magnets. All things that have reached the molecule stage are naturally more or less magnetic (see Faraday), there are many angles of spin or revolution and rates of speed, and consequently many degrees of vortical power. The larger masses such as suns, etc., rushing and whirling through the ether (and interwhirling in themselves) produce immense vortices in the ether. They must do so because you cannot have two portions of matter filling the same portion of space at the same time. The rushing masses must displace the smaller portions of matter that they meet, and with which they clash; and the ether must flow into the network of holes made by the passing sun or planet. These vortices, or stresses in the ether, assist to keep the suns, planets, etc., in their orbits.

This theory regards motion as a condition of matter, and rest as a relative effect of material motion exerted in different ways or directions. From this material motion all natural phenomena proceed. It does not in any way deal with the supernatural, it is purely natural philosophy.

In order to enable us to consider what follows with greater ease, let us construct a mental spring-board in the form of a syllogism, as follows:—

1. Material combinations are the result of material motion.
2. Material motion must have speed.
3. Therefore material combinations are the result of speed of material portions.

THE SPEED THEORY.

Radium, discovered by Madam Curie, is a great aid to the solution of the Riddle of the Universe.

One of the greatest generalisations of science (termed the conservation of energy) teaches that energy, however it may be changed from one form of force into another, is never destroyed or originated.

Another great generalisation (the persistence of matter) teaches that no substance comes into existence out of nothing, and no substance is ever annihilated.

Both of these great laws Radium, on its first discovery, appeared to contradict, by, apparently, continuously throwing off heat, or energy, without getting colder, although the dissipated energy was not replaced from external sources; and it appeared to continuously emanate matter from itself without growing less.

This extraordinary behaviour naturally excited great interest in scientific minds, and set the experimenters at work. Among that able and learned band of men Professors Rutherford and Soddy devoted their attention to the study of Radium and kindred radio-active substances. After most painstaking and ingenious researches, they were rewarded by being able to devise and publish an explanation showing that Radium, like other substances, confirmed the great theories of the conservation of energy and the persistence of matter.

*The explanation was that some of the atoms of Radium were constantly disintegrating into smaller portions of

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*Dr. W. Hampson's "Radium explained."

matter, and that the energy continually developed by the Radium is due to the liberation of the energy contained in the atom in the form of interatomic vibration of the corpuscles of which the atoms consist.

This explanation appeared at first to some to be revolutionary, because it had been held and taught by great authorities that the atom was the ultimately minute and inseparable portion of matter. Nevertheless, it has been thought that a readjustment was necessary, which conceived the atoms to be separable into minute, and still further separable into minuter, parts; and that the elements (less than one hundred in number) resolved for us by the chemists must be conceived as complex products derived from fewer and simpler radicals, possibly only one. The explanation of Professors Rutherford and Soddy, which is growing in acceptance, confirms this idea.

Radium, then, consists of atoms of matter; these atoms are built up of corpuscles, and these corpuscles possibly of minute granules of matter moving and revolving at a tremendous speed; and some of the corpuscles disintegrate, and shoot forth from the atom minute portions of matter at enormous speed.

Here we approach the discovery of what appears to be a great truth of far-reaching and immense importance.

The things that give its character to Radium are the speed, weight, and movements of its atoms, corpuscles, and granules.

This is the great truth, and appears to be the key to the Riddle of the Universe—viz., that the speed* and weight of the granules, corpuscles, atoms, and molecules, and the peculiarities of movement resulting from that speed and weight, give to substances their distinguishing characteristics, and account for all natural phenomena.

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*Speed, and movement, may take many forms.

Illustrations are dangerous things in an argument; but, if apposite and not unduly pressed, they may be helpful.

Start one hundred men on a foot race of a mile. Soon they will fall into groups, as a result of the different rates of speed at which they travel; and these groups will possess mobility and stability dependent on the speed and movement of the individuals forming the groups.

Imagine an immense billiard table and a vast number of billiard balls rolling about the table; the balls will fall into groups according to the speed and movement of the individual balls, and those groups will have a sort of mobility and stability until interfered with by other groups or balls crashing against them with sufficient force and weight to break up the group, with the result that new groups are formed. What is true in this respect of masses of matter, the size of men or billiard balls, is true of smaller and larger portions of matter.

A long strip of wood usually burns slowly. The reason for this is that only the particles of those parts of the wood nearest the burning part become energised to move with sufficient speed to combine with the oxygen. The particles of the unburning portion of wood are moving too slowly to unite with the oxygen; if they were moving at sufficient speed to combine with the oxygen, the wood would be burnt up in a flash.

Every combustible substance has its *kindling temperature, at which its particles move at sufficient speed to combine with the oxygen.

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*Although they may kindle more or less slowly at different temperatures the truth remains.

One of the most difficult problems in connection with this subject is the following:—Why is it that in combustion, although the particles must move at varying rates of speed, only the products (and the same products each time) with which we are acquainted are produced? The explanation appears to be as follows: Imagine a box of billiard balls revolving rapidly, and the balls suddenly thrown therefrom at high rates of speed on to a very large billiard table; some during their movements would eventuate into groups. Repeat this as often as you like, and if the forces are exactly alike in all particulars, on each occasion you will get like results. You must have definite temperatures to produce definite chemical results, and with like forces you of course get like results. It is possible that in some cases other substances are in the act of formation, in a fraction of time, amidst the war of the atoms; but the battling of the atoms breaks up those nascent combinations before they can escape, and only those combinations remain stable and escape to which it is possible so to do under the given circumstances.

The atoms having definite weights (the granules of matter must have some weight, and according to their number, or weight, in the atom so must be its weight), the resulting combination must have definite weights; and as you get like results under like circumstances, you get a like rule of combination weights.

Returning to the strip of wood, it is evident that it is the speed, weight, and movement of the atoms or molecules, etc., that give to the substance its character that we term wood. If the atoms, etc., moved at sufficient speed to unite with oxygen in combustion, it would result in and be something that certainly is not wood. They must move more slowly than the oxygen to be wood. Their rate of speed and arrangement makes them wood.

The granules, corpuscles, atoms, and molecules are continually moving, and at different speeds, through space, and as a result of contact and the exercise of force, are grouping, breaking up, and grouping again according to their speed, weight, and movement; and this speed, weight, movement and arrangement gives to substances their distinguishing characteristics. The names we give to the temporary arrangements of matter are merely words.

The granules of matter, and their necessary accompaniment of speed, weight, movement and arrangement are sufficient to account for the universe, and all natural phenomena, which follow as a natural consequence of the existence of those granules and their accompaniment of speed, weight, movement, and arrangement.

The strong support given to the theory by the works of Sir Norman Lockyer and others on the stars may be here alluded to. In the hottest stars hydrogen and proto-hydrogen are the only predominant elements. The energy is so great that the granules, atoms, etc., are kept at such a high rate of speed that it is impossible for them by degrees of cooling to attain such variety of speeds as to produce a great variety of combinations of substance. When all are driven at such high speed differences are eliminated, and matter appears near to its simplicity. It is the difference in the rates of speed between the very highest and the lowest, combined with the varieties of movement and arrangement and the question of weight, which has an important bearing when the groups clash, that accounts for the many differences of material combinations of substance.

The truth of the theory is also demonstrated daily the world over by electrical accumulators. Energy, in the form of material motion, is being forced into accumulators and stored there for future use. The only way in which it is possible for this storage to take place, is in the increased speed of movement, and consequent differences of arrangement of the small portions of matter composing the chemical substances in the accumulators. When the stored up energy is run off by the current, to produce electric light, or in the performance of other electrical work, the speed of the portions runs down; and the chemical changes vary from that to this, and from this to that, as the energy is forced in or run off. A more convincing proof it would be difficult to find in science or nature.

The term most likely to cause confusion in the mind of the reader in considering this theory is the well-known expression, gravitation; but this is merely a word for a form of force not clearly comprehended by the users, and therefore to be deprecated as unsatisfying and unsatisfactory—it is, in fact, a non-explanation. An explanation may be found in the following ideas. The ether is matter, this is proved by abundant electrical phenomena, amongst the most interesting and convincing of which are, perhaps, those in connection with wireless telegraphy.* "Hertz discovered that electrical oscillations, produced in a so-called open electric circuit possessing capacity and inductance, create in the surrounding ether a disturbance which is called an electric wave. This wave can be detected at a distance by means of devices which are now termed Cymoscopes or Wave Detectors." Marconi, working on this basis laid by Hertz, utilised electric waves for telegraphic purposes. Marconi's great discovery was the importance of the antenna, or aerial wire, and of the earth connection. In its earliest form his transmitting apparatus consisted of an induction coil, one secondary terminal being connected to a plate or cylinder of wire upheld

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**Ten Years of the Marconi System.* By the Marconi Company, Limited.

by a pole. The secondary terminals of the induction coil were also connected to a spark ball discharger; and in some of his experiments he employed a kite or balloon to uphold the elevated wire or plate, now called the antenna. In the primary circuit of the induction coil he inserted a key for breaking and making the primary current in accordance with the signals of the Morse alphabet. By pressing the key in the primary circuit of the induction coil for a longer or shorter time electric sparks of longer or shorter duration were made to pass between the spark balls of the induction coil. Corresponding to these, trains of electrical oscillations are set up in the insulated wire or strip called the antenna; and, corresponding again to these groups of oscillations, trains of electric waves, the duration of which corresponds with the time during which the primary circuit of the induction coil is closed, are sent out into space in all directions. At the receiving station (many miles away, and with the improved apparatus, thousands of miles away) an antenna or insulated conductor is erected similar to that at the transmitting station; and by this means the waves are intercepted and carried through the transmitter to the Morse printer, by which the message is printed off.

My point is that the action of matter on the ether by contact, producing the waves which again act by contact on matter, proves the ether to be material substance.

We have, therefore, surrounding the earth, an ocean of water, an ocean of air, and an ocean of ether (the ether filling all unoccupied space, but the air and water occupying only a limited area) all subject to wave motion and material movement. This wave motion in the respective oceans is caused by the motion of the material portions forming the oceans of water, air, or ether .It appears necessary to press this home, simple as it is, because there appears to be with some writers a tendency to obscure the fundamental facts under a cloud of words about the wave theory. The wave is made up of, and is caused by, the movement of many small portions of matter.

The stellar and planetary bodies, rushing and revolving in their orbits, and interwhirling in themselves, through the ether, form vortices of immense scope and great power in the ether, that sweep all smaller bodies within their influence towards the path of the star or planet. Corpuscles, atoms, etc., are merely infinitely smaller bodies, all making their smaller vortices in the ether by their movement. Other corpuscles, atoms, etc., moving at the same speed, approach and coalesce; the same speed keeps them moving together, assisted by the action of the vortical force set up by their movements, which helps to bind them more firmly into groups, until the groups are broken up by groups of greater weight or speed, when new combinations are made. This explanation accounts for natural phenomena in a simple, clear, and natural manner, and eliminates confusing and non-explanatory terms, substituting in place thereof material motion and vortical force.

Let Z = an atom or molecule, Y = the ether force that keeps Z in position, A = a celestial body, B = the ether force that keeps it in position; then X million times Y will keep X million times Z in position. Therefore, as $A = Z \times X$ millions, and $B = Y \times X$ millions, B will (other things being equal) be sufficient to perform its function of keeping A in position.

Imagine you have before you silver sand, mineral salts, water, a creeper, a tree, and also a hemp and a wire rope.

If gravitation as conceived in the Newtonian philosophy was a fact, the particles of sand would have a tendency to cohere in the form of rock; but it gives no evidence of any such tendency. From the sand, salts, and water we cannot make a rope; but let there be damp earth, containing the necessary materials, in which we plant seeds, and nature will spin us a rope, or make a branch, showing that the power of things to resist strain is a matter of construction, not of gravitation. This power to resist strain does not depend on what we call life, but is independent of it, as may be seen from things that we term dead, or that never had life, as in the cases of the hemp and the wire ropes. Nature constructs as she will, or can.

At the beginning of this treatise the fundamental law of material combination was stated. Let us take up another link in the chain, and reason backwards. Imagine a growing tree, composed of many living vegetable cells, the life and growth of which depend upon sun force, that in the natural laboratory, the tree, carries on much chemical work. Sun force is material motion. Suppose the tree to consist of one hundred million vegetable cells that owe their life and growth to sun force; then one million, one thousand, one hundred, one cell will owe life and growth to material motion; and if one cell, all cells. All the protoplasmic life and work is carried on, and depends upon the subtile movements of the granules, corpuscles, atoms, and molecules, of the protoplasm and ether; and, as there is no barrier in the protoplasm between vegetable and animal life, we arrive at the inevitable conclusion that all natural phenomena, organic or inorganic, living or dead, owe existence to material motion, and are the result of the speed of material portions, moving, grouping, re-grouping, and ever changing under the rule of material motion, in a succession of dancing and resting pictures and problems of exquisite intricacy, variety, and beauty.

Some may ask: If that be so, why is it that material motion does not now originate life on the earth? It is not absolutely certain that it does not; but if it no longer does so, the reply is, that circumstances are not now favourable; the earth has cooled, the material movements of its particles, atoms, etc., are slower. At one time, when it was hotter, and the movements were more rapid, this earth must have been a vast hot-bed for the production of vegetable and animal life.

"One fundamental fact in plant physiology practically contradicts the assumption that life has never originated from inorganic substances; namely, at the present time living substance is being continually formed in the plant cell from simple inorganic compounds, carbonic acid, water, sulphates, nitrates, etc. Between the small seed put into the earth in the spring and the huge plant that grows from it during the summer, an enormous quantity of living substance has been formed out of the purely inorganic substances of the environment, and when winter comes, almost the whole quantity of this living substance returns again to simpler inorganic compounds. It is here seen how inseparably related are inorganic and organic nature, how living substance is originating continually from lifeless substance, and is continually being decomposed again into lifeless substance. Nageli ('84) one of the most talented botanists, says rightly:—'One fact—that in organisms inorganic substance becomes organic substance, and that the organic returns completely to the inorganic—is sufficient to enable us to deduce by means of the law of causation the spontaneous origin of organic nature from inorganic.' If in the physical world all things stand in casual connection with one another, if all phenomena proceed along natural paths, then organisms, which build themselves up from and finally disintegrate into the substances of which organic nature consists, must have originated primitively from inorganic compounds. To deny spontaneous generation is to proclaim a miracle." (Verworn). When we think of the beginning of organic life we must not think primarily of carbonic acid and ammonia; for they are the end of life, not the beginning. The beginning lies rather in *cyanogen. Hence the problem of the origin of living substance culminates in the question:—How does cyanogen arise? Here, organic chemistry presents the highly significant fact, that cyanogen and its compounds arise only in an incandescent heat, *e.g.*, when the necessary nitrogenous compounds are brought in contact with burning coal, or when the mass is heated to a white heat. Accordingly nothing is clearer than the possibility of the formation of cyanogen-compounds when the earth was wholly or partially in a fiery or heated state. Moreover chemistry shows how the other essential constituents of proteid, such as the hydrocarbons, the alcohol radicals, etc., can likewise arise synthetically in heat. It is seen how strongly and remarkably all facts of chemistry point to fire as the force that has produced by synthesis the constituents of proteid. In other words life is derived from fire, and its fundamental conditions were laid down at a time when the earth was still an incandescent ball (Pfluger).

Life, be it said, is an arrangement of suitable materials, by material motion, in suitable form, moving within certain rates of speed. Too much speed, and death ensues. Too little speed also causes death.

Heat, light, colour, and sound are sensations caused by material motion. Thought is also a sensation, arising from the same cause. Increased motion causes the sensation of heat; the motion is conveyed to the brain, giving the sensa-

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*Cyanogen, *see* Addenda.

tion of thought, and we think that it is hotter. As a result of the sensation of thought, we think, or have the sensation that we are; we cannot think that we are not.

Freely moving matter is free; all its temporary bonds are doomed to destruction. Thought, being the product of freely moving matter, must also be free. Efforts have been made to bind and tame it, but all the petty efforts of man to confine Nature end in time in failure; she rends and consumes the bonds in the majesty of her progress. Free thought, by its clashing and warring, speeds thought to greater brilliance, or cools it to more tempered and exact argument, and is beneficial. Even the incoherent ravings of a poor lunatic have their uses if they drive us, as they should, to a close scientific study of their causes, in order that the disorder may be alleviated or abolished. Nature is greater than we, her puny product.

The master key to the whole subject is material motion. Minor keys are: 1. The speed of material portions; 2. Like forces, with like matter, produce like results. The slightest variation in force or speed, or arrangement of matter, may give a tendency to variation in results; and this, carried far enough, accounts for the variation in individuals and species. Darwin's work dealt more with the outward manifestation, this deals with the material power, in the form of material motion.

It has been previously stated that electricity and magnetism are material motion in special forms or modes, and only in operation when material motion takes those forms or modes. Lightning is electricity. It is admitted that lightning takes the line of least resistance, as any physical force will do. This means that lightning follows the path of the best conducting material, and that it is surrounded by matter of less conductivity, it is insulated.

It is not necessary to remind electricians that insulating matter may have a higher or lower rate of conductive capacity, all that is necessary for it to be able to insulate, however imperfectly, is that it should not conduct as well as the matter along which the lightning finds its path. This suggests the thought that electricity is of the nature of material motion and stress within an envelope, or it may be several envelopes with varying degrees of insulation. This envelope may be of air, or other matter, or of other matter within air or mixed with air. Electrical engineers insert linings within their insulating covers, and nature often does the same. They may have one cell, or many cells grouped in innumerable ways, that is also nature's method. At their best they only feebly follow her. Here we approach what is very suggestive with regard to wireless telegraphy. It appears probable that the motion connected with this phenomena is electricity until it leaves the antenna, and that then it is transformed into mere material motion, in the form of wave motion of the ether, unless we make our definition of electricity too loose for practical purposes. When we look out into the infinity of nature we see the difficulty of a precise definition; heat (which is material motion) appears to shade off imperceptibly into electricity (which is material motion in a certain condition of stress), and back again from electricity to heat. This is nature's way to solve by imperceptible gradations (although she can act in cataclysms), we see it not only in this case, but in so many, in the gradations from non-living to living, of vegetable and animal, etc. Nature does not in order to oblige us continually work by creations, (unless the word be used figuratively, to cover much), but by evolutions, and by imperceptible gradations to great effects. Adumbrations and gradual blendings onward to the completed picture, and gallery after gallery of simple, or intricate, and exquisite beauty. My definitions, therefore, are more for practical use, than absolutely correct.

The ether waves strike upon the receiver, and the material motion is again transformed into electricity, or material motion and stress within an insulating envelope. If this is true it gives us a beautiful illustration of the transforming of electricity into mere material motion, and of that motion again into electricity. It also suggests what looks like a matter of great practical importance. If it is correct, it appears possible that electrical engineers will be able in the future to do without many millions of miles of that very expensive material copper wire, and that with the insertion of an antenna at one end and a receiver at the other of their insulated tube (now called cable) they may be able to force along the tube, and to store their electricity in the accumulators. This with the cheapening of the cost of dynamos should save untold millions for the human race.

But to return to our main subject. Nature's method is the electro-magnetic, cell mode, she is constantly forming non-living, as well as living cells; and if the adage " all cells from cells " is true, as no doubt it is, the living cells must have proceeded from the non-living. The mistake has been in not carrying the cell theory into inanimate as well as animate nature, thus making the cell theory true to nature. Electricity is material motion and stress within an envelope. If the enveloping matter is not sufficiently strong, has a weak spot, a breach occurs, and the electricity rushes into what, if the insulation is sufficient, becomes another insulated container of electric power (say a reservoir or cell) and this process is continually going on in nature, and must do so, is inevitable from its constitution and motion; and is one of its most constant processes. Cells, or containers, of many shapes and sizes are continually being formed and broken up, both in inanimate and animate nature. The whole business, including the electrical stress, is caused by portions of matter in motion.

We know that all things that have reached the molecule stage are more or less magnetic, and consequently electric. Portions of matter meet, clash, and thereby set up a revolution of the portions, and cause electrical and magnetic effects; and some of these in that condition of motion as a result of their movements form around themselves an envelope or skin, or skins, which may be of air, or other matter, within which the electrical and magnetic stresses and effects are produced. Much depends on the quality and strength of the skin, what I term "power of skin." In many cases of inanimate phenomena, and in primitive forms of living matter, when the internal stress becomes too great for the power of the envelope or skin, it stretches; and at its weakest point a rupture takes place, a daughter cell is formed by breaking away from the parent mass; and the mother cell as a cell perhaps perishes, or, as in some cases, two cells are formed. There are many forms of division of cells, with various results. In the case of some others the power of the skin is sufficient to resist dissolution (although cells may be multiplied by division within) but not to resist the distortion of its shape, and consequently, depending on the pressures within and without, and the power of the *skin, we get an immense variety of form and size of both non-living and of living matter. It is the power of the skin, combined with the pressures within and without, etc., that gives us great trees and large animals, and such an immense variety of trees and animals. The power of the skin, and the capacity to form it, is also one of the great secrets of

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*Take the word skin as meaning envelope.

heredity, and the differences of the power of the skin, etc., is that which allows of such great variation. But it is not only the power of the skin, there is also the question of the *size of the cells. The cells of some things are larger than the cells of others, and contain a larger quantity, if not a better quality, of nutrient matter; and consequently the daughter cells are larger, and as they increase and grow you get a larger object. There is more, however, than the mere question of size, there is likeness. Why an elephant and not a fish? The reply is that it is a question of the most delicate play of complex physical forces. Every reproductive cell, if it could be seen in its entirety, has its distinctive points and potentialities; and within and without are working forces that under similar conditions have only one result, limited in extent and †definite in end, so that with mathematical precision they produce effects that follow one another to a certain conclusion. Variation is caused by interference with those conditions or forces.

The question of sex, after its first evolution, appears to depend upon the virility of the parent cells. If the male reproductive cell is the more virile it will be the dominant factor and *vice versa*. When families are mixed in sex it results from the swing of the pendulum of virility between the reproductive cells. Physiologists know how many things go to produce virility, constitution, food, air, etc.

A living cell is an electro-magnetic, and an electro-chemical machine, within an envelope, and living organisms of a higher type are electro-magnetic and electro-chemical machines containing within an envelope many such small machines, the combined effects of which give the necessary electro-magnetic and electro-chemical forces to produce motion, and the other phenomena characteristic of living things, aided by various stimuli, such as heat, etc. The whole being material motion; but motion at various speeds and in many ways.

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*Physiologists would, perhaps more correctly, say that cells are generally nearly of the same size; but some are larger and some smaller; and that bulk is caused by increase of either.

†Definite in end in the sense that given certain conditions and forces certain results must follow.

The electrician forms a battery by putting a plate of copper and a plate of zinc into a suitable fluid, and electro-chemical results follow. When he withdraws the fluid from the cell the results apparently cease. It is the speed of movement, and arrangement, of the portions of matter in the copper, zinc, and the fluid that produces the electro-chemical effects. Nature, like the electrician, puts her positive and negative materials within her living cells, that she has formed by enveloping the materials in some species of envelope, and adds a suitable fluid, electro-chemical results follow. When by the operations of nature the fluid is withdrawn, the results apparently cease, and the cell or cells (or seeds) appear lifeless; but when she again supplies the suitable fluid under suitable conditions they again give the electro-chemical phenomena of life, unless they have been left long without fluid, and the molecular clockwork has, while without the fluid, run down below the energy, or speed of movement, necessary to the manifestation of electro-chemical effects when the fluid is again added.

It is evident that it is only necessary for a cell in inanimate nature, that contains the necessary materials, having the needful energy, within an insulating envelope, to be supplied with the suitable fluid for the phenomena of life to be manifested. How simple after all is the origin of life, the difficulty has been in our want of understanding. It may be a little difficult at first glance to see in all its fulness and beauty;

but when you remember that the difference between life and death in the seed, and cell, is really the difference between the feebleness and swiftness of movements, in various ways, of small portions of matter the subject becomes quite easy. If they move at sufficient speed, on the addition of the needful fluid, life is manifested; if the speed of movement is too feeble it is death, they are inanimate, life is consequently at bottom a question of speed.

The difference between the living and the non-living is the capacity possessed, as a result of speed, by the living to produce the electro-chemical and other effects within their cells that result in growth. Nevertheless the living are not independent, they also are dependent on external as well as internal physical law, they are electro-chemical machines connected with and controlled by the great machine nature; and perhaps the best definition of life is that it consists in an arrangement of suitable materials, by material motion, in suitable form, moving within certain rates of speed. As we approach the borderland between animate and inanimate nature it is almost as difficult to separate the living from the non-living as it is to distinguish between the animal and vegetable; and it is a question whether we ought not to extend the definition of life to include much that is now regarded as not living, although perhaps much harm may not be done if we remember the difficulty of drawing an abrupt dividing line between the two Kingdoms. They appear to be imperceptibly merged in one another. This is nature's way and may be taken to be one of the indications of the unity of nature, and her dependence on natural law. You may not like it, you may prefer what looks to you more clear and definite; but nature declines to work according to our dictation, she has her own inimitable way of gradual and imperceptible mutation.

The great physiologist Verworn writes that:—"The fact stands out clearly and distinctly that life from its beginning has been dependent upon the external conditions of the earth's surface. In a mathematical sense, life is a function of the earth's development. Living substance could not exist while the earth was a molten sphere without a solid, cool, crust; it was obliged to appear with the same inevitable necessity as a chemical combination when the necessary conditions were given; and it was obliged to change its form and its composition in the same measure as the external conditions of life changed in the course of the earth's development. It is only a portion of the earth's matter. The combination of this matter into living substance was as much the necessary product of the earth's development as was the origin of water. It is an inevitable result of the progressive cooling of the masses that formed the earth's crust. Likewise, the chemical, physical, and morphological characteristics of existing living substance are the necessary result of the influence of the external conditions of life upon the internal relations of past living substance. Internal and external vital conditions are inseparably correlated, and the expression of this correlation is life." The whole being caused by material motion. When the earth and its surroundings are sufficiently cold, when material motion is too feeble for the manifestation of life, vital phenomena on this planet will cease to exist.

The subject is so vast and so exquisitely beautiful that one might write for ever, and there is a danger of eloquent gush; but I spare the reader.

Some persons may fear to amend the Newtonian philosophy, lest some great catastrophe happen. They may argue: "How can I give up this idea? What was to keep matter together before this universe was evolved, and what is to keep matter together if the universe be destroyed?" I think that we can ease their minds. Space is illimitable, and eternity has neither beginning nor end. Eternal space is all space. Matter cannot possibly drop out; there is nowhere for it to drop to. Instead of needing holding together, it needed the very reverse—the freest possible opportunity of movement, which is allowed to it by my theory, then vortication, as developed, keeps it together, or unlooses it, under physical force and law, as nature in her working compels.

Our finite thoughts are apt at times to be petty, and to move in a groove. In dealing with natural philosophy we need to overcome this style of thought—to give wings to our instructed imaginations, that we may realise the exquisite and infinite beauty and grandeur of nature. Free moving matter may have, during eternity, evolved unnumbered universes and peoples before our present one that will dissipate to dust; and from that dissipated freely moving matter countless universes and peoples in succession may be evolved, speeding on in never-ending cycles of beauty, majesty, and glory, perhaps towards perfection, when shame and sorrow shall be no more; but, in any case, in an endless chain of intricate loveliness, dazzling brilliance, and gorgeous beauty. Finally, whatever the original cause of motion, the speed theory must be true, because two portions of matter moving adjacent to one another along a straight line at equal rates of speed must continue to move together so long as their speeds remain equal, and they do not receive any interference. This, firmly grasped and rightly applied, is the key to unbar the way into paradise after paradise of nature; and reveal the hidden beauties of her varied and secret work.

May sweet reasonableness, courtesy, and peace be with us evermore.

ADDENDA.

N.B.—The sense in which the word "vortices" is used is as expressing the motions communicated to the surrounding ether by the rush and whirl of the stars, planets, atoms, etc., resulting in vortical force.

Cyanogen, this is merely a name for an arrangement of material portions, moving at certain speeds, in certain ways; and consequently having certain characteristics. Never let either simple or difficult words blunt your perception of this fundamental truth about substances.

Physicists, Geologists, etc., know that many modifications of physical law are brought about by physical law, by the formation of cements, by pressures, etc., etc. These have not been mentioned in detail. I have given the outline, the filling in and decoration is left to abler hands to perform at their inclination and leisure.

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